airelectronics

UAV AUTOPILOTS

U-Pilot & U-Pilot OEM Manual

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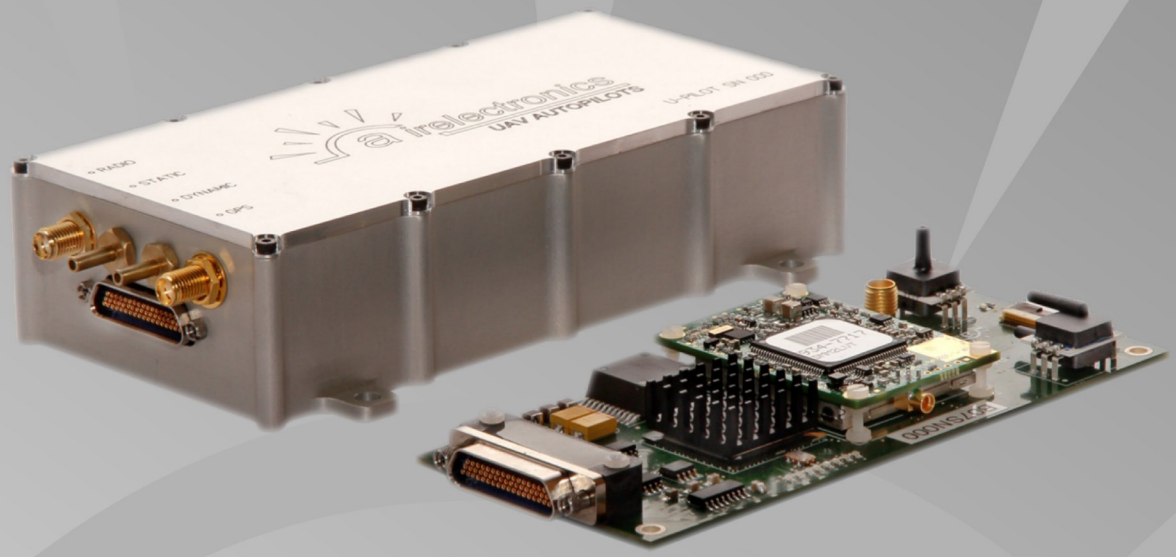

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1 General System Introduction

Airelectronics has developed a complete solution for both rotary and fixed wing UAVs. The system is composed of:

- U-Pilot or U-Pilot OEM
- U-Ground or U-Ground OEM
- U-See Software

U-Pilot manages and controls the vehicle from Take-off to Landing, being capable of controlling any kind of aircraft including fixed wing, helicopters and multicopters.

U-Pilot is completely capable of following a flight plan with up to 200 real-time editable points. Once the flight plan is loaded on U-Pilot, it is independent of operator instructions, and in case of a communications failure, U-Pilot starts a Return Home and Land manoeuvre which would safely land the UAV on the Runway Point.

Thanks to its versatility, U-Pilot can control any payload on board the UAV such as cameras, parachutes or sensors. These devices can be real time controlled by a computer operator or by U-Pilot automatically.

The FPGA technology used in U-Pilot and U-Ground allows the system to have several logic working in parallel with the main processors. U-Pilot has working in parallel:

- Up to 31 PWM (Pulse-Width Modulation) or GPIO (General Purpose Input / Output).
- 3 ADC inputs (Analogical Digital Converter) to monitor the voltages of 3 batteries on the UAV.
- 4 serial ports RS232 to communicate with payloads, external magnetometers, etc.
- A radio with up to 100 km[1]
- GPS, dynamic and static pressure sensors, a magnetometer, gyroscopes and accelerometers.

U-Pilot is built using a two parallel microprocessor approach:

- One processor handling the state estimation and control of the UAV, using hardware acceleration to calculate high speed algorithms.
- A second processor handles of the mission at high level, communications with U-Ground and the Payload.
- The processors do not spend time handling low-level tasks, as these tasks are processed in parallel by dedicated logic of the FPGA.

Due to the fact that those two processors are working in parallel and there is dedicated electronics processing the serial ports, sensors, inputs and outputs, the system is capable of recalculating its position, orientation and closing control loops at 1000 Hz. This control speed provides a great navigation accuracy and control.

On the ground segment, Airelectronics has both U-Ground and U-See.

U-Ground is a ground station that mainly acts as a relay of command and data between U-Pilot and U-See software. Besides acting as data relay, U-Ground provides useful

1 Range may vary with the frequency band used. Default is 900 MHz but legal limitations in some countries may change this.

information to U-Pilot such as U-Ground position and pressures. U-Ground hardware is also capable of handling a Antenna tracking system.

U-See software is a user friendly program that runs in any personal computer running Windows or Linux.

Using U-See, the UAV operator can monitor the current state of the vehicle, control the UAV or modify the vehicle mission in real time.

1.1 Concept of system operation

The system consists of an U-Pilot installed on an aircraft connected to a U-Ground through a radio link. (See figure 1 attached below)

U-Ground has its own radio link to communicate with the U-Pilot and a RS-232 port to relay the data and command between a PC running U-See and the U-Pilot on-board the vehicle.

Under certain circumstances such as aircraft integration and characterization, a Futaba Emitter is recommended in order to provide manual override of the vehicle.

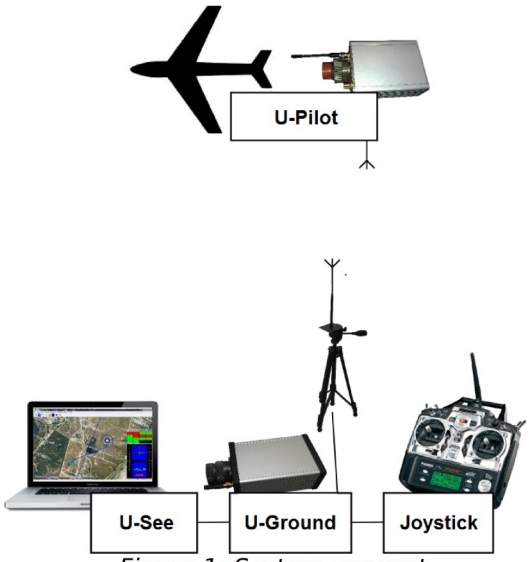


Figure 1: System concept

The mission operation team is usually formed by two people:

- A External Pilot who will handle the Futaba Joystick in case a manual control of the UAV is desired (specially during the development and adjustment phase).
- A U-See operator that will command the mission using a computer.

When using the UAV for surveillance purposes, a camera operator is recommended.

2 Controllable Air vehicles

U-Pilot is able to control Fixed Wing and Rotary Wing vehicles. Each unit is configured for a specific type of vehicle.

2.1 Fixed wing

Fixed wing can take-off automatically on a runway, hand launched or catapulted. The automatic landing can be done using a parachute or on a runway.

At the time of performing the connections of the servos to the U-Pilot refer to U-Pilot connections.

2.1.1 Conventional configuration fixed wing

Conventional configuration planes are supported with redundant elevator and separated channels for left and right ailerons and flaps.

Other configurations/equipment are supported (spoilers support, parachute deployment for landing, etc.) upon request. Please contact us for this kind of configuration.

2.1.2 Flying wing configuration

Tailless flying wing is supported and aileron control is separated in two channels per wing to improve reliability and enable usage of butterfly air-brake deployment.

2.2 Rotary wing

Rotary wing configuration group different vehicles. U-Pilot can be configured for the following type (extra configuration will be added in the future)

2.2.1 Helicopter (Swash-plate 4)

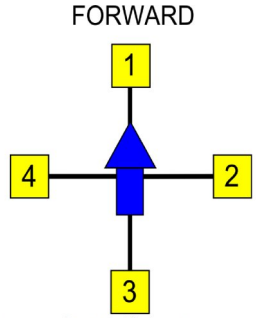


Figure 2: Helicopter servo distribution

The helicopter has a swash-plate driven by four servos. These servos should be connected to U-Pilot following the attached schematic.

Servo 1 is forward mounted.

Servo 2 is right mounted.

Servo 3 is back mounted.

Servo 4 is left mounted.

The U-Pilot motors connection is detailed in U-Pilot connections.

2.2.2 Helicopter (Swash-plate 3)

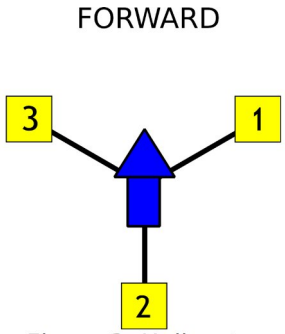


Figure 3: Helicopter (Swash-plate 3) servo distribution

The helicopter configured as swash-plate 3 has a swash-plate driven by three servos. These servos should be connected to U-Pilot following the attached schematic.

Servo 1 is forward-right mounted.

Servo 2 is back mounted.

Servo 3 is forward-left mounted.

The U-Pilot motors connection is detailed in U-Pilot connections.

2.2.3 Helicopter (Direct Drive)

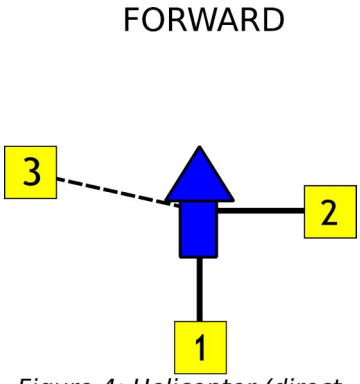


Figure 4: Helicopter (direct swash plate) servo distribution

The helicopter has a swash-plate driven by three servos. These servos should be connected to U-Pilot following the attached schematic.

Servo 1 drives cyclic pitch

Servo 2 drives cyclic roll

Servo 3 drives collective

Note that as every movement of the swash-plate is assigned exclusively to a servo, you don't need to respect the right/left or forward/back indications of the diagram, as you can always check “inverse” in the servos adjustment step.

The U-Pilot motors connection is detailed in U-Pilot connections.

2.2.4 Quadcopter

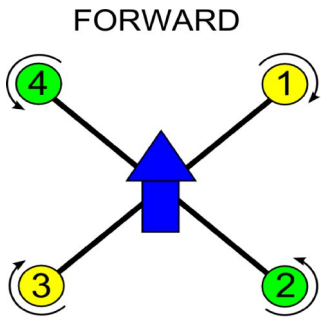


Figure 5: Quadcopter motors distribution

The quadcopter motors distribution and the rotation direction is represented in the attached schematic.

The quadcopter motors distribution and the rotation direction is represented in the attached schematic.

Notice that motors number 1-3 must turn clockwise and motors number 2-4 must turn anticlockwise.

The U-Pilot motors connection is detailed in U-Pilot_connections.

2.2.5 Hexacopter

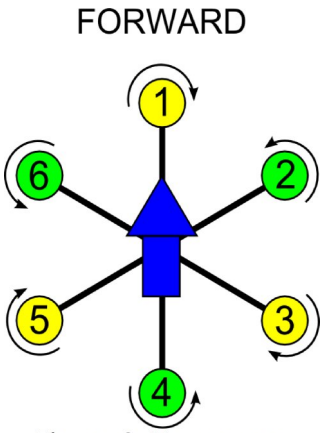


Figure 6: Hexacopter motors distribution

The hexacopter motors distribution and the rotation direction is represented in the attached schematic.

Notice that motors number 1-3-5 must turn clockwise and motors number 2-4-6 must turn anticlockwise.

The U-Pilot motors connection is detailed in U-Pilot_connections.

2.2.6 Octocopter

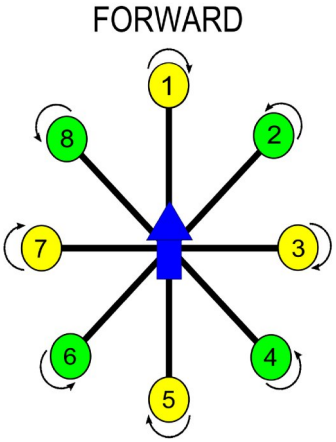


Figure 7: Octopter motors distribution

The octocopter motors distribution and the rotation direction is represented in the attached schematic.

Notice that motors number 1-3-5-7 must turn clockwise and motors number 2-4-6-8 must turn anticlockwise.

The U-Pilot motors connection is detailed in U-Pilot connections.

3 U-Pilot

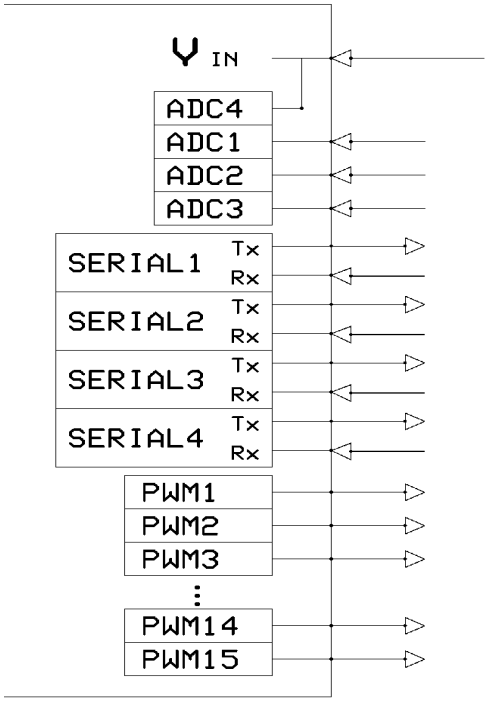


Figure 8: U-Pilot I/O Schematic

The U-Pilot is powered in the range from 6.0V to 24V, view Power Supply. This allows the connection of U-Pilot directly to a 2S LiPo battery without adding possible points of failure in the system.

If the system uses 6V servos, U-Pilot can be connected directly to the servo power and save weight.

The power installation can be done in several different ways described in Power Supply section.

U-Pilot has three ADC available channels to monitor system voltages, and it is possible to connect a Hall-Effect amperometer sensor to control the discharge of battery in electric UAVs.

There are up to 31 PWM outputs signals at 50, 200, 300, 333 or 560Hz frequencies and 1500 or 760 us pulses.

PWM at 50Hz is the most common way to control servos and it will be accepted by almost any servo in the market. This signal pulses every 20 ms (milliseconds), and depending on the length of these pulses the servo will move to different positions.

Digital servos (300Hz) can accept much faster control input and are the recommended choice when control rotary wing aircraft.

Upon request, all the PWM lines can be reconfigured to output or input any other digital signal.

There are 4 serial ports also available for additional devices use, such as cameras or magnetometers.

Serial ports are automatically adapted to the baud rate of the devices connected to it. The voltage levels for the serial ports are the standard +12V/-12V.

Connector pin configuration is detailed on U-Pilot Connections section.

3.1 U-Pilot and U-Pilot OEM

U-Pilot can be acquired in two versions, the standard version, enclosed in an aluminium box, and the OEM version that is not enclosed, ready to be embedded into the customer system.

Unless told otherwise, the explanations provided by this document are valid for both versions. When different explanations are required, this document will state it.

3.2 Power supply

U-Pilot power supply accepts voltages in a range from 6.0V to 24V. Main power voltage is directly connected to the ADC channel number 4, thus allowing monitor of AP battery and

check for voltage supply stability. This level is displayed as an internal battery 4 on the U-See state window (Consult U-See manual for details)

CAUTION: Power the Autopilot at a voltage OUT of range can cause IRREVERSIBLE DAMAGE to the system. Please read carefully this manual and do not hesitate to contact us (www.airelectronics.es) if needed.

Typical power consumption about 4 Watt, but the power system should be prepared to withstand 7 Watts peaks. This consumption will mean an intensity consumption of 0.8 Amp. at 6V or 0.4 Amp. at 12 V.

3.3 Monitoring Engine Data

A better estimation of the battery status on electric vehicles is available by adding an amperometer connected to the ADC3 on the U-Pilot. The amperometer is a linear hall effect sensor supplied by Airelectronics.

This configuration allows the user to improve the efficiency of the flight. For further information of its usage check the *Engine Data section* of the *U-See* manual.

3.4 Microprocessors structure

The Autopilot has two microprocessors (CPUs).

- **CPU Mission control**. This CPU manages Communications to and from ground segment, the management of payloads and, in general, operations that are not flight related.
- **CPU Flight control**. This CPU produces the surfaces commands and control the attitude of the aircraft. This processor access all its sensors in a non-blocking way and it is always evaluating current position, attitude and control.

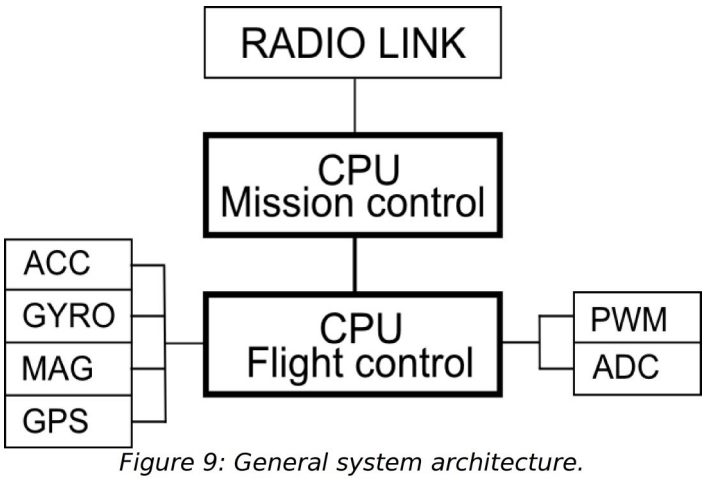


Figure 9: General system architecture.

3.5 Sensors

There are several sensors inside U-Pilot and all of them have their own electronics design inside the system taking care of them, this gives the highest reliability and performance to the system. The sensors are:

- Accelerometers
- Gyroscopes
- GPS with Satellite Based Augmentation System
- Several Static Pressure Sensor to improve accuracy in different altitude ranges.
- Several Dynamic Pressure Sensors for higher accuracy during take-off and landing operations. Different sensors account for different speed segments of the mission. These sensors are only used in Fixed Wing UAVs

Besides these internal sensors, for rotary wing we use an external magnetometer. It is connected to the system through RS-232 port and interfaces with dedicated electronics in U-Pilot. Due to the fact that this sensor is external it can be placed far from any electromagnetic noise inside the UAV. However, it must be connected to the proper main connector on U-Pilot. (See section 3.6)

If, for some reason, a external dynamic pressure sensor is needed, the system has the provisions to make use of an Airelectronics external I2C sensor that can be mounted separately from U-Pilot. This sensor is only provided upon request.

The sensor suite is very flexible and can be modified to reflect a customer requirement on the system.

3.6 U-Pilot Connections

This section provides the required information about U-Pilot connections, including:

- Main connector connections
- Pressure connections
- Radio-Link connections
- GPS antenna connections.
- Magnetometer connections

3.6.1 U-Pilot Main Connector

The aerial part of connector used for the U-Pilot is provided in the Installation Kit. Cables in the aerial connector are colour coded. The following table describes the function of every pin in the main connector in U-Pilot and the corresponding colour coded cable in the supplied aerial connector.

The pin configuration used depending on the UAV vehicle is detailed in the following table and the corresponding connector diagram.

NOTE: Please, take into account than in these tables, Tx and Rx suffix are referred to U-Pilot. This is: a line marked as “Magnetometer Rx” is the pin dedicated to receive data from the magnetometer, and thus, must be connected to the sending pin in the magnetometer connector.

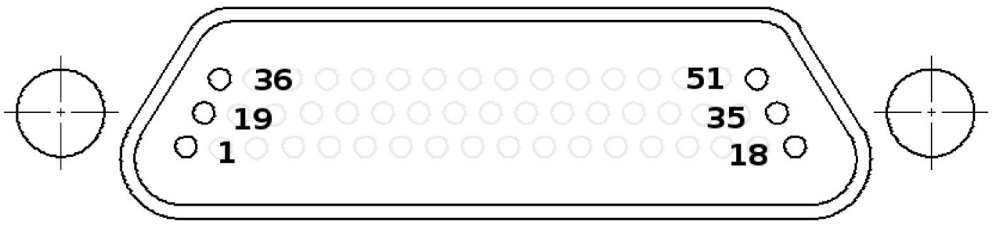


Figure : Main connector on U-Pilot as seen from the front.

PIN	I/O	FixedWing	Flying Wing	Helicopter Swash-plate 4	Helicopter Swash-plate 3	Helicopter Direct Swash-plate	Cable Colour
1	In	ADC 2	ADC 2	ADC 2	ADC 2	ADC 2	Black
2	In	ADC 1 / Battery	ADC 1 / Battery	ADC 1 / Battery	ADC 1 / Battery	ADC 1 / Battery	Brown
3	DC in	V_{IN}	V_{IN}	V_{IN}	V_{IN}	V_{IN}	Red
4	GND	**Ground**	**Ground**	**Ground**	**Ground**	**Ground**	Orange
5	In	Engine ECU Rx	Engine ECU Rx	Magnetometer Rx	Magnetometer Rx	Magnetometer Rx	Yellow
6	Out	Engine ECU Tx	Engine ECU Tx	Magnetometer Tx	Magnetometer Tx	Magnetometer Tx	Green
7	Out	Engine Kill	Engine Kill	Engine Kill	Engine Kill	Engine Kill	Blue
8	GND	**Ground**	**Ground**	**Ground**	**Ground**	**Ground**	Purple
9	In	DGPS Rx	DGPS Rx	DGPS Rx	DGPS Rx	DGPS Rx	Grey
10	Out	DGPS Tx	DGPS Tx	DGPS Tx	DGPS Tx	DGPS Tx	White
11	GND	**Ground**	**Ground**	**Ground**	**Ground**	**Ground**	Black
12	Out	1-Wire Temperature Sensor	1-Wire Temperature Sensor	1-Wire Temperature Sensor	1-Wire Temperature Sensor	1-Wire Temperature Sensor	Brown
13	In	Payload Rx	Payload Rx	Payload Rx	Payload Rx	Payload Rx	Red
14	Out	Payload Tx	Payload Tx	Payload Tx	Payload Tx	Payload Tx	Orange
15	GND	**Ground**	**Ground**	**Ground**	**Ground**	**Ground**	Yellow
16	NC	Reserved	Reserved	Reserved	Reserved	Reserved	Green
17	In	RS232 Port 1 Rx	RS232 Port 1 Rx	RS232 Port 1 Rx	RS232 Port 1 Rx	RS232 Port 1 Rx	Blue
18	Out	RS232 Port 1 Tx	RS232 Port 1 Tx	RS232 Port 1 Tx	RS232 Port 1 Tx	RS232 Port 1 Tx	Purple
19	In	ADC 3 / Amperimeter	ADC 3 / Amperimeter	ADC 3 / Amperimeter	ADC 3 / Amperimeter	ADC 3 / Amperimeter	Grey
20	DC in	V_{IN}	V_{IN}	V_{IN}	V_{IN}	V_{IN}	White
21	In	Camera Pan	Camera Pan	Camera Pan	Camera Pan	Camera Pan	Black
22	In	Camera Tilt	Camera Tilt	Camera Tilt	Camera Tilt	Camera Tilt	Brown
23	Out	Camera Roll	Camera Roll	Camera Roll	Camera Roll	Camera Roll	Red
24	NC	Camera Shutter	Camera Shutter	Camera Shutter	Camera Shutter	Camera Shutter	Orange
25	NC	Reserved	Reserved	Reserved	Reserved	Reserved	Yellow
26	NC	Reserved	Reserved	Reserved	Reserved	Reserved	Green
27	NC	Reserved	Reserved	Reserved	Reserved	Reserved	Blue
28	NC	Reserved	Reserved	Reserved	Reserved	Reserved	Purple
29	NC	Reserved	Reserved	Reserved	Reserved	Reserved	Grey
30	NC	Reserved	Reserved	Reserved	Reserved	Reserved	White
31	NC	Reserved	Reserved	Reserved	Reserved	Reserved	Black
32	NC	Reserved	Reserved	Reserved	Reserved	Reserved	Brown
33	NC	Reserved	Reserved	Reserved	Reserved	Reserved	Red
34	NC	Reserved	Reserved	Reserved	Reserved	Reserved	Orange
35	Out	DGPS-TTL Correction	DGPS-TTL Correction	DGPS-TTL Correction	DGPS-TTL Correction	DGPS-TTL Correction	Yellow
36	GND	**Ground**	**Ground**	**Ground**	**Ground**	**Ground**	Green
37	Out	Throttle	Throttle	Throttle	Throttle	Throttle	Blue
38	Out	Right Aileron	Out Right aileron	Swash-plate 1	Swash-plate 1	Cyclic Pitch	Purple
39	Out	Elevator	In Left aileron	Swash-plate 2	Swash-plate 2	Cyclic Roll	Grey
40	Out	Rudder	Rudder	Tail Servo	Tail Servo	Tail Servo	White
41	Out	Left Aileron	Out Left aileron	Swash-plate 3	Swash-plate 3	Collective	Black
42	Out	Left Flap	Left Flap	Swash-plate 4	Reserved	Reserved	Brown
43	Out	Elevator 2	In Right Aileron	Reserved	Reserved	Reserved	Red
44	Out	Right Flap	Right Flap	Reserved	Reserved	Reserved	Orange
45	Out	Nose Wheel	Nose Wheel	Reserved	Reserved	Reserved	Yellow
46	NC	2nd Aileron Right	Reserved	Reserved	Reserved	Reserved	Green
47	NC	2nd Aileron Left	Reserved	Reserved	Reserved	Reserved	Blue
48	NC	2nd Flap Right	Reserved	Reserved	Reserved	Reserved	Purple
49	NC	2nd Flap Left	Reserved	Reserved	Reserved	Reserved	Grey
50	NC	Reserved	Reserved	Reserved	Reserved	Reserved	White
51	NC	Reserved	Reserved	Reserved	Reserved	Reserved	Black

PIN	I/O	Quadcopter	Hexacopter	Octocopter	Cable Colour
1	In	AADC 2	ADC 2	ADC 2	Black
2	In	ADC 1 / Battery	ADC 1 / Battery	ADC 1 / Battery	Brown
3	DC in	V_{IN}	V_{IN}	V_{IN}	Red
4	GND	**Ground**	**Ground**	**Ground**	Orange
5	In	Magnetometer Rx	Magnetometer Rx	Magnetometer Rx	Yellow
6	Out	Magnetometer Tx	Magnetometer Tx	Magnetometer Tx	Green
7	Out	Engine Kill	Engine Kill	Engine Kill	Blue
8	GND	**Ground**	**Ground**	**Ground**	Purple
9	In	DGPS Rx	DGPS Rx	DGPS Rx	Grey
10	Out	DGPS Tx	DGPS Tx	DGPS Tx	White
11	GND	**Ground**	**Ground**	**Ground**	Black
12	Out	1-Wire Temperature Sensor	1-Wire Temperature Sensor	1-Wire Temperature Sensor	Brown
13	In	Payload Rx	Payload Rx	Payload Rx	Red
14	Out	Payload Tx	Payload Tx	Payload Tx	Orange
15	GND	**Ground**	**Ground**	**Ground**	Yellow
16	NC	Reserved	Reserved	Reserved	Green
17	In	RS232 Port 1 Rx	RS232 Port 1 Rx	RS232 Port 1 Rx	Blue
18	Out	RS232 Port 1 Tx	RS232 Port 1 Tx	RS232 Port 1 Tx	Purple
19	In	ADC 3 / Amperimeter In	ADC 3 / Amperimeter In	ADC 3 / Amperimeter In	Grey
20	DC in	V_{IN}	V_{IN}	V_{IN}	White
21	In	Camera Pan	Camera Pan	Camera Pan	Black
22	In	Camera Tilt	Camera Tilt	Camera Tilt	Brown
23	Out	Camera Roll	Camera Roll	Camera Roll	Red
24	NC	Camera Shutter	Camera Shutter	Camera Shutter	Orange
25	NC	Reserved	Reserved	Reserved	Yellow
26	NC	Reserved	Reserved	Reserved	Green
27	NC	Reserved	Reserved	Reserved	Blue
28	NC	Reserved	Reserved	Reserved	Purple
29	NC	Reserved	Reserved	Reserved	Grey
30	NC	Reserved	Reserved	Reserved	White
31	NC	Reserved	Reserved	Reserved	Black
32	NC	Reserved	Reserved	Reserved	Brown
33	NC	Reserved	Reserved	Reserved	Red
34	NC	Reserved	Reserved	Reserved	Orange
35	In	Reserved	Reserved	Reserved	Yellow
36	GND	**Ground**	**Ground**	**Ground**	Green
37	Out	Motor 1	Motor 1	Motor 1	Blue
38	Out	Motor 2	Motor 2	Motor 2	Purple
39	Out	Motor 3	Motor 3	Motor 3	Grey
40	Out	Motor 4	Motor 4	Motor 4	White
41	Out	Reserved	Motor 5	Motor 5	Black
42	Out	Reserved	Motor 6	Motor 6	Brown
43	Out	Reserved	Reserved	Motor 7	Red
44	Out	Reserved	Reserved	Motor 8	Orange
45	Out	Nose Wheel	Nose Wheel	Nose Wheel	Yellow
46	NC	Reserved	Reserved	Reserved	Green
47	NC	Reserved	Reserved	Reserved	Blue
48	NC	Reserved	Reserved	Reserved	Purple
49	NC	Reserved	Reserved	Reserved	Grey
50	NC	Reserved	Reserved	Reserved	White
51	NC	Reserved	Reserved	Reserved	Black

3.6.2 Pressure sensors connections

U-Pilot has two pressure sensors:

- Static pressure sensor
- Dynamic pressure sensor

For fixed wing vehicles, static and dynamic pressure sensors are required.

For rotary wing vehicles only static pressure sensor is required.

The static pressure tap may be left unconnected if U-Pilot environment is not sealed or pressurized. Otherwise it must be connected to the ambient pressure.

The dynamic pressure must be connected to a pitot tube, installed away from turbulent flows such as propeller down-wash.

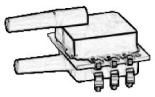
The pressure connection installations differ in U-Pilot and U-Pilot OEM. Depending on your U-Ground version, you have to refer to the apropriate subsection

3.6.2.1 U-Pilot (Box) pressure connections

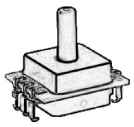
U-Pilot pressure connectors are properly labelled on the front face of the box: “STATIC” for static pressure and “DYNAMIC” for dynamic pressure.

The static pressure sensor can be left unconnected if U-Pilot environment is not pressurized or sealed.

3.6.2.2 U-Pilot OEM pressure connections



Dynamic



Static

Figure 10: Pressure sensors

The OEM version of U-Pilot exposes directly the pressure sensors. The sensors can be identified with the image.

The static pressure sensor can be left unconnected if U-Pilot environment is not pressurized or sealed.

The dynamic pressure (pitot) must be connected to the lower conduit of the sensor. The upper conduit must be connected to the static tap, and may be left unconnected under the same circumstances as the static sensor.

3.6.3 Radio-link antenna connections

The radio-link antenna connection depends on the version of U-Pilot. Depending on your U-Ground version, please refer to the apropriate subsection.

3.6.3.1 U-Pilot (Box) Radio-link connection

The radio-link antenna must be connected to U-Pilot with an SMA-connector to the connector labelled as “RADIO” in the front face of U-Pilot box.

3.6.3.2 U-Pilot OEM Radio-link connection

The radio-link antenna must be connected to the radio-module using and MMCX connector.

3.6.4 GPS antenna connections

The GPS antenna installation depends on the version of U-Pilot. Depending on your U-Ground version, please refer to the apropriate subsection.

3.6.4.1 U-Pilot (Box) GPS connection

The GPS antenna must be connected to U-Pilot with an SMA-connector to the connector labelled as “GPS” in the front face of U-Pilot box.

3.6.4.2 U-Pilot OEM GPS connection

U-Pilot OEM has two GPS connectors:

- UFL connector.
- SMA connector.

The GPS antenna can be connected to any of the two connectors but NOT BOTH. The location of the UFL and SMA connectors is described in the mechanical drawings for the OEM version.

3.6.5 Magnetometer connections

For rotary wing platforms, it is need to connect an external magnetometer to U-Pilot.

It is encased in metal and it interfaces and powers through a DB9 connector. Error: no se encuentra la fuente de referencia and Error: no se encuentra la fuente de referencia detail the proper wiring to connect the magnetometer to U-Pilot. Note, through, that this magnetometer must be supplied with DC between 6.5V and 15V.

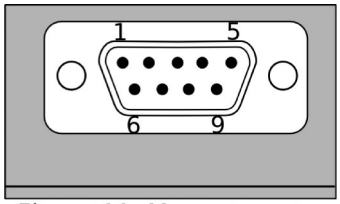
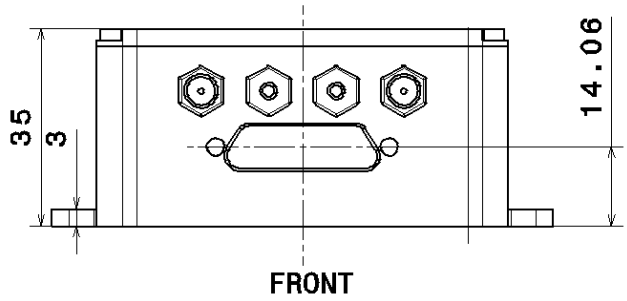


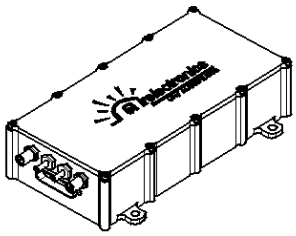
Figure 11: Magnetometer connector viewed from the front.

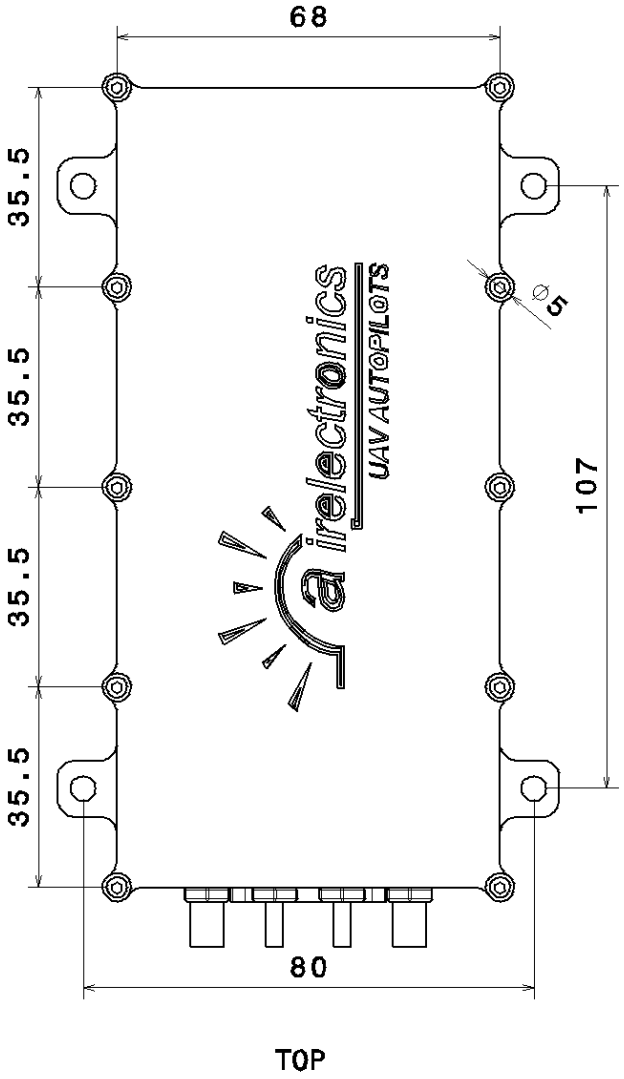
Magnetometer PIN	Function	Connected to
2	TX	Pin 6 (Magnetometer TX in main connector)
3	RD	Pin 5 (Magnetometer RX in main connector)
5	GND	Ground
9	Vcc	Magnetometer power supply.(6.5V-15V)

Table 1: Magnetometer connection list

Appendix A Box Mechanical Drawing



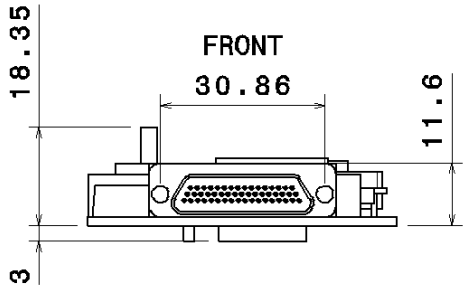


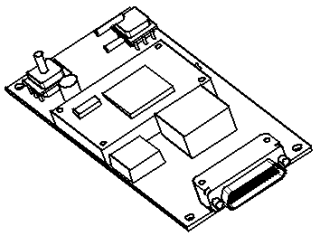


Airelectronics

Distances are in mm

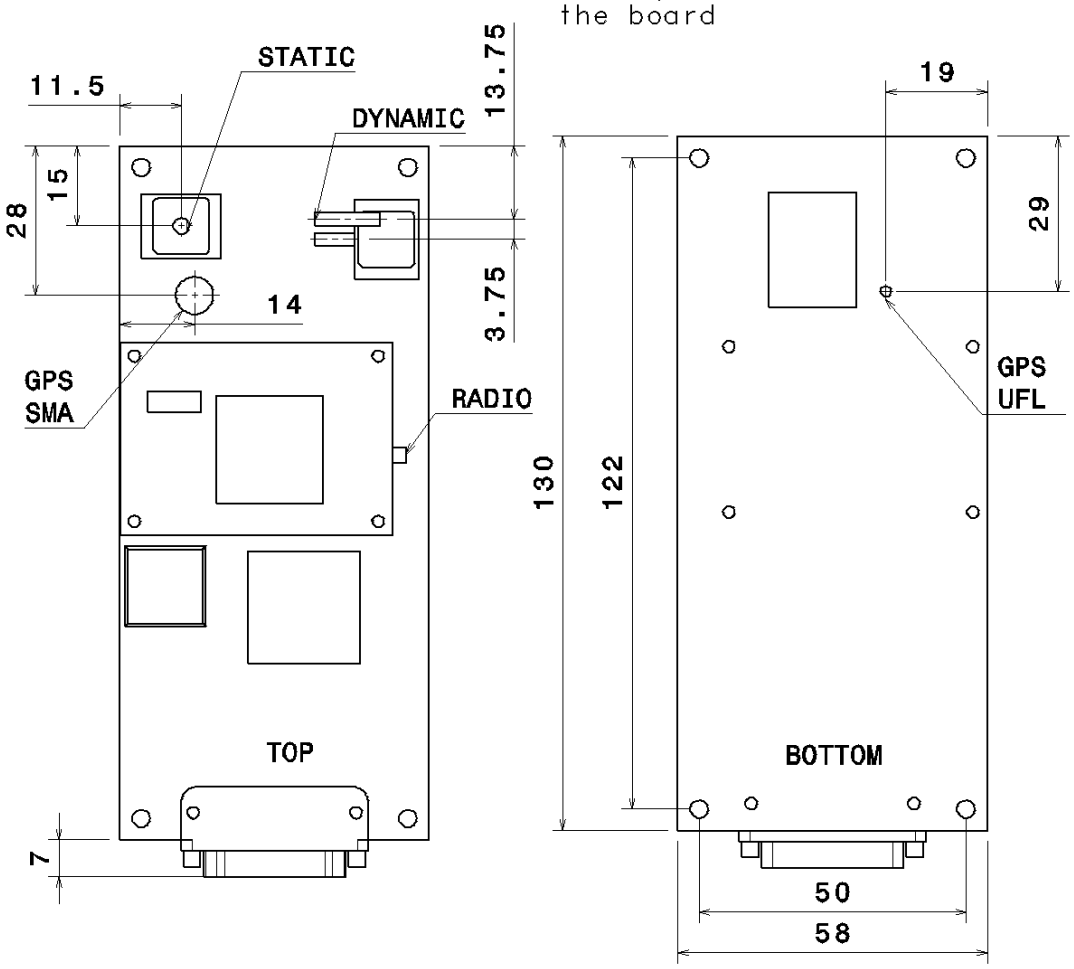
Appendix B OEM Mechanical Drawing





All distances are in mm

A clearance distance of 3mm is requred at the bottom of the board



Appendix C Guide for determining servo reverse

When a new vehicle is configured with U-Pilot and U-See it is needed to determine if “Reverse” check-box should be active. Follow the following tables to determine if your servos need reversal.

Fixed Wing servos[2]

Conventional configuration

Servo	Min commanded action	Max Commanded action
Throttle	Carburator closed	Carburator opened
Aileron Right	Right aileron trailing edge up	Right aileron trailing edge down
Elevator	Elevator trailing edge up	Elevator trailing edge down
Rudder	Rudder trailing edge right	Rudder trailing edge left
Aileron Left	Left aileron trailing edge down	Left aileron trailing edge up
Wheel	Steer right	Steer left

Flying Wing

Servo	Min commanded action	Max Commanded action
Throttle	Carburator closed / motor stopped	Carburator opened / motor at max speed
Outward Left aileron	Left aileron trailing edge down	Left aileron trailing edge up
Inward Left Aileron	Left aileron trailing edge down	Left aileron trailing edge up
Rudder	Rudder trailing edge right	Rudder trailing edge left
Outward Right Aileron	Right aileron trailing edge up	Right aileron trailing edge down
Inward Right Aileron	Right aileron trailing edge up	Right aileron trailing edge down
Wheel	Steer right	Steer left

Helicopter Servos

When referring the swash-plate, left/right/front/back will be always referred as watching the swash-plate from above and in the direction of forward movement of the vehicle

Direct Servos

Servo	Min commanded action	Max Commanded action
Throttle	Carburator closed	Carburator opened
Collective	Full Swash-plate down	Full Swash-plate up
Cyclic Roll	Swash-plate tilts right	Swash-plate tilts left
Cyclic Pitch	Swash-plate tilts backwards	Swash-plate tilts forward
Rudder	Tail rotor acts to make tail rotates clockwise	Tail rotor acts to make tail rotates anti-clockwise

2 This section assumes conventional aircraft configuration. Canard configurations require different settings, please contact Airelectronics if that's your case

Swash-plate 4

Servo	Min commanded action	Max Commanded action
Throttle	Carburator closed	Carburator opened
Swash-plate 1	Corresponding swash-plate section moves down	Corresponding swash-plate section moves up
Swash-plate 2	Corresponding swash-plate section moves down	Corresponding swash-plate section moves up
Swash-plate 3	Corresponding swash-plate section moves down	Corresponding swash-plate section moves up
Swash-plate 4	Corresponding swash-plate section moves down	Corresponding swash-plate section moves up
Rudder	Tail rotor acts to make tail rotates clockwise	Tail rotor acts to make tail rotates anti-clockwise

Swash-plate 3

Servo	Min commanded action	Max Commanded action
Throttle	Carburator closed	Carburator opened
Swash-plate 1	Corresponding swash-plate section moves down	Corresponding swash-plate section moves up
Swash-plate 2	Corresponding swash-plate section moves down	Corresponding swash-plate section moves up
Swash-plate 3	Corresponding swash-plate section moves down	Corresponding swash plate section moves up
Rudder	Tail rotor acts to make tail rotates clockwise	Tail rotor acts to make tail rotates anti-clockwise

Quadcopter

Servo	Min commanded action	Max Commanded action
Engine 1	Motor stopped	Motor at max speed
Engine 2	Motor stopped	Motor at max speed
Engine 3	Motor stopped	Motor at max speed
Engine 4	Motor stopped	Motor at max speed

Hexacopter

Servo	Min commanded action	Max Commanded action
Engine 1	Motor stopped	Motor at max speed
Engine 2	Motor stopped	Motor at max speed
Engine 3	Motor stopped	Motor at max speed
Engine 4	Motor stopped	Motor at max speed
Engine 5	Motor stopped	Motor at max speed
Engine 6	Motor stopped	Motor at max speed

Octocopter

Servo	Min commanded action	Max Commanded action
Engine 1	Motor stopped	Motor at max speed
Engine 2	Motor stopped	Motor at max speed
Engine 6	Motor stopped	Motor at max speed
Engine 4	Motor stopped	Motor at max speed
Engine 5	Motor stopped	Motor at max speed
Engine 6	Motor stopped	Motor at max speed
Engine 7	Motor stopped	Motor at max speed
Engine 8	Motor stopped	Motor at max speed

Appendix D Changelog

This annex describes changes introduced to this document.

Date	Changes
2015/02/19	• Version of document up to 1.25 • Changed wrong aileron sense for Flying wing. • Added GPS, Pressure and Radio-Link connections. • Added mechanical drawings for Box and OEM versions
2014/10/27	• Version of document started 0.5 • Created Document

If you need a previous version of documentation, please, contact us at info@airelectronics.es